2.2.2 Hydrological Resources and Issues

This section describes existing surface water and groundwater resources for the study area. Existing data were collected through analysis of state, federal, and county databases and maps. This study area includes a large amount of known perennial streams and lakes along with some associated unique and impaired waters. Gaps in floodplain data occur because some of the Indian reservations passing through the focus areas do not have delineated floodplains. Although only two sole source aquifers are designated within the study area, the ADWR classifies all of Arizona's aquifers as drinking water aquifers, which are described in detail below under groundwater resources.

Major Watercourses and Drainage Features

The three focus areas in this study area include almost half of the known perennial streams and lakes in Arizona. The greatest concentrations of these important water features are over 5,000 feet asl and are given in Table 2-1, which lists perennial lakes and reservoirs, perennial rivers and streams, and unique intermittent streams. The Arizona State Land Department (ASLD) classifications were used to describe perennial versus intermittent flow and unique waters. The description of unique waters applies to intermittent streams that pass through environmentally protected areas that include the following:

- Protected riparian habitats
- Wildlife refuges
- Spring-fed streams
- Unique slot canyons or geologic features
- Established recreational areas (fishing, canoeing, swimming etc.)
- U.S. Forest Service (USFS) campgrounds
- National or state parks

Table 2-1 – Perennial Lakes and Reservoirs

PERENNIAL LAKES AND RESERVOIRS

BODY OF WATER (1,2)	NEAREST TOWN	FOCUS AREA	COUNTY (3)	FLOODPLAIN MAPPING AVAILABLE (4)	TOWNSHIP	RANGE
Allens Reservoir	Safford	CC	Gr		7S	25E
Arivaca Lake	Nogales	CS	Sc		22S	11E
Ashurst Lake	Flagstaff	MR	Co		19N	9E
Atcheson Reservoir	Greer	MR	A		7N	28E
Bear Canyon Lake	Heber	MR	N		12N	13E
Becker Lake	Springerville	MR	A		9N	29E
Big Lake	Alpine	CC	A		6N	28E
Black Canyon Lake	Overgaard	MR	N		11N	15E
Blue Ridge Reservoir	Clints Well	MR	Co		14N	11E
Bunch Reservoir	Greer	MR	A		7N	27E
Carnero Lake	Springerville	MR	A		8N	27E
Chevelon Canyon Lake	Heber	MR	N		13N	14E
Coconino Reservoir	Flagstaff	MR	Co		19N	9E
Concho Lake	St. Johns	MR	A		12N	26E
Crescent Lake	Alpine	CC	A		6N	28E
Dankworth Lake	Safford	CC	Gr	yes	8S	26E
Dry Lake	Holbrook	MR	N	yes	14N	18E

BODY OF WATER (1,2)	NEAREST TOWN	FOCUS AREA	COUNTY (3)	FLOODPLAIN MAPPING AVAILABLE (4)	TOWNSHIP	RANGE
Fools Hollow Lake	Show Low	MR	N		10N	22E
Hawley Lake	Pinetop	MR	N		7N	24E
Horseshoe Cienega Lake	Pinetop	MR	N		7N	25E
Kinnikinick Lake	Flagstaff	MR	Co		18N	10E
Knoll Lake	Payson	MR	Co		12N	12E
Lake Sierra Blanca	Alpine	CC	A		6N	29E
Lee Valley Reservoir	Greer	CC	A		6N	27E
Little Mormon Lake	Show Low	MR	N	yes	10N	22E
Little Reservoir	St. Johns	MR	A		13N	28E
Long Lake	Clints Well	MR	Co		16N	11E
Luna Lake	Alpine	CC	A		5N	31E
Lyman Lake	St. Johns	MR	A		11N	28E
Mexican Hay Lake	Greer	MR	A		7N	28E
Morman Lake	Flagstaff	MR	Co		18N	9E
Nelson Reservoir	Springerville	MR	A		8N	30E
Norton Reservoir	Springerville	MR	A		8N	27E
Pacheta Lake	Greer	CC	A		4N	27E
Parker Canyon Lake	Sierra Vista	CS	Cs		23S	19E
Parks Lake (1)	Duncan	CC	Gr		10S	30E
Patagonia Lake	Patagonia	CS	SC	yes	22S	14E
Pena Blanca Lake	Nogales	CS	SC		23S	12E
Rainbow Lake	Lakeside	MR	N	yes	9N	22E
Reservation Lake	Greer	CC	A		5N	27E
Riggs Lake	Safford	CC	Gr		8S	23E
River Reservoir	Greer	MR	A		7N	27E
Rogers Reservoir	Safford	CC	Gr		6S	24E
Roper Lake	Safford	CC	Gr		8S	26E
San Carlos Reservoir	San Carlos	CC	Gi, P, Gr		3S	19E
Scott Reservoir	Lakeside	MR	N	yes	9N	22E
Show Low Lake	Show Low	MR	N	yes	9N	22E
Soldier Annex Lake	Clints Well	MR	Co		16N	11E
Soldier Lake	Clints Well	MR	Co		16N	11E
Stehr Lake	Camp Verde	MR	Gi		12N	6E
Stoneman Lake	Camp Verde	MR	Co		16N	8E
Sunrise Lake	Springerville	MR	A		7N	27E
Theodore Roosevelt Lake	Globe-Miami	MR	Gi	yes	5N	11E
Tonto Lake	Alpine	CC	A		4N	27E
Tremaine Lake	Flagstaff	MR	Co		16N	10E
Tunnel Reservoir	Greer	MR	A		7N	27E
Whipple Lake	Show Low	MR	N	yes	10N	22E
White Mtn Lake	Show Low	MR	N	yes	11N	22E
White Mtn Reservoir	Springerville	MR	A		7N	27E
Wilcox Playa (1)	Wilcox	CS	Cs	yes	15S	25E
Willow Springs Lake	Heber	MR	N		11N	14E
Woodland Reservoir	Pinetop	MR	N	yes	9N	23E
Woods Canyon Lake	Heber	MR	N		11N	13E

NOTES:

1) Lake indicated is a natural lake bed that is intermittent (fills only in wet years).

PERENNIAL RIVERS AND STREAMS

BODY OF WATER (1,2)	NEAREST TOWN	FOCUS AREA	COUNTY (3)	PART OF MAJOR RIVER WATERSHED	FLOODPLAIN MAPPING AVAILABLE (4)	TOWNSHIP	RANGE
Aravaipa Creek	Winkelman	CC	P	San Pedro		6S	17E
Bear Wallow Creek	Alpine	CC	Gle	Black	yes	3N	28E
Beaver Creek	Alpine	CC	Gle	Black		5N	30E
Black River	Hannagan Meadow	CC	Gle	Salt (upper)	yes	4N	28E
Black River, E. Fork	Alpine	CC	Gle	Black		6N	29E
Black River, W. Fork	Alpine	CC	Gle	Black		6N	27E
Blue River	Alpine	CC	Gle	San Francisco	yes	5N	32E
Bonita Creek	Safford	CC	Gr	Gila		5S	27E
Campbell Blue Creek	Alpine	CC	A, Gle	Blue		5N	29E
Eagle Creek	Clifton	CC	Gle	Gila (upper)		1N	28E
Gila River (lower)	Globe	CC	Gi, P	Colorado (lower)		3S	18E
Gila River (upper)	Safford	CC	Gr, Gle	San Carlos Res (4)	yes	6S	28E
Grant Creek	Alpine	CC	Gle	Blue		3N	30E
Riggs Creek	Alpine	CC	A	Little Colorado		7N	29E
Salt River	Globe	CC	Gi	Gila (lower)		4N	20E
San Carlos River	San Carlos	CC	Gr	San Carlos Res (4)		1N	21E
San Francisco River	Clifton	CC	Gle	Gila (upper)	yes	2S	32E (Note 6)
Willow Creek	Clifton	CC	Gr	Eagle Creek	yes	1S	27E
Babocomari River	Sierra Vista	CS	Sc	San Pedro	yes	21S	18E
San Pedro River	Sierra Vista	CS	Cs	Gila (lower)	yes	24S	24E (Note 7)
San Simon River	Bowie	CS	Cs	Gila	yes	15S	32E (Note 6)
Santa Cruz River	Nogales	CS	SC	Gila (lower)	yes	24S	17E (Note 7)
Sonoita Creek	Nogales	CS	SC	Santa Cruz	yes	20S	17E
Canyon Creek	Young	MR	Gi, N	Salt (upper)		7N	15E
Carrizo Creek	Young	MR	Gi, N	Salt (upper)		9N	18E
Cherry Creek	Young	MR	Gi	Salt (upper)		8N	13E
Chevelon Creek	Heber	MR	N	Little Colorado		14N	14E
Christopher Creek	Payson	MR	Gi	Tonto Creek		11N	13E
Cibeque Creek	Young	MR	Gi, N	Salt (upper)		8N	17E
Clear Creek, East	Winslow	MR	N	Little Colorado	yes	14N	11E
Clear Creek, West	Clints Well	MR	Co	Verde		14N	8E
Fossil Creek	Camp Verde	MR	Gi	Verde		12N	7E
Haigler Creek	Young	MR	Gi	Tonto Creek		10N	13E
Little Colorado River	Springerville	MR	N, A	Colorado	yes	8N	30E

BODY OF WATER (1,2)	NEAREST TOWN	FOCUS AREA	COUNTY (3)	PART OF MAJOR RIVER WATERSHED	FLOODPLAIN MAPPING AVAILABLE (4)	TOWNSHIP	RANGE
Little Colorado River, W. Fork	Greer	MR	A	Little Colorado		6N	27E
Pine Creek	Payson	MR	Gi	East Verde	yes	11N	9E
Puerco River	Holbrook	MR	N, A	Little Colorado		22N	30E
Salome Creek	Young	MR	Gi	Roosevelt Lake (4)		5N	12E
Silver Creek	Show Low	MR	N	Little Colorado	yes	11N	23E
Spring Creek	Young	MR	Gi	Tonto Creek		8N	13E
Tonto Creek	Payson	MR	Gi	Salt (upper)	yes	11N	12E
Verde River, East	Payson	MR	Gi	Verde	yes	11N	10E
Wet Beaver Creek	Sedona	MR	Co	Verde		15N	7E
White River, North Fork	Pinetop	MR	N	Salt (upper)		7N	24E
Zuni River	Sanders	MR	A	Little Colorado		14N	27E

NOTES:

1) Rivers and creeks listed here are perinneal streams, or are intermittant streams with special characteristics Locations (Township and Range) refer to the uppermost limit of the perennial reach of the named river or stream.
2) Co=Coconino, N=Navajo, A=Apache, Gi=Gila, Gr=Graham, Gle=Greenlee, SC=Santa Cruz, Cs=Cochise, P=Pinal
3) Floodplain mapping per the Q3 data for Arizona; September, 1998 and recent or pending floodplain mapping submitted to FEMA.
4) Indicated stream flows directly into Roosevelt Lake along the Salt River (upper)
The (lower) section of the Salt River is downstream of Roosevelt Lake
5) Indicated stream flows directly into San Carlos Lake along the Gila River (upper)
The (lower) section of the Gila River is downstream of San Carlos Reservoir
6) Rivers indicated originate in New Mexico
7) Rivers indicated originate in Mexico

The study area includes many major watersheds (drainage features), which are shown in Table 2-2 below.

Table 2-2 – Major Watersheds within the Study Area

Mogollon Focus Area	Copper Country Focus Area	Cochise Santa-Cruz Focus Area
• East Verde River • Tonto Creek • Lower tributaries of the Salt River • Most of the White River • Little Colorado River • Theodore Roosevelt Lake • Numerous minor lakes above the Mogollon Rim and in White Mountain area	• White River • Black River • Blue River • San Francisco River • Upper Gila River • San Simon River (intermittent, but a large watershed) • San Carlos River • San Carlos Lake • Numerous minor lakes in White Mountain area and Mount Graham area	• Upper portion of San Simon River (intermittent, but a large watershed) • Santa Cruz River • San Pedro River • Wilcox Playa • Whitewater Draw (intermittent, but a large watershed)

Flood Hazards

The Federal Emergency Management Agency (FEMA) publishes Floodplain Insurance Rate Maps (FIRM) that are available online through the FEMA map store. Hard-copy versions of the FIRM mapping are readily available through each county floodplain administrator. These delineated water bodies are indicated on Table 2-1, Perennial Lakes and Reservoirs, described above.

As of 2008, all Arizona counties are digitizing their published floodplain maps; this effort should be completed and approved by FEMA by 2013. As part of this digitization effort, some counties will be adding floodplain data from recent flood insurance studies, recent floodplain/floodway delineation, and other private drainage studies where new or revised floodplain delineation was required. Although the updated FIRM data are not currently available, any future developments and roadway corridor studies will need to include the most recent data. Therefore, each county floodplain administrator must be consulted for the most recent floodplain data available.

The White Mountain Apache, San Carlos Apache, and Zuni communities (Indian reservations) are within one or more of the three focus areas. No floodplain hazard areas have been mapped on these reservations.

The flood insurance studies (reports) published by FEMA are listed on Table 2-3. Each county in the three focus areas has a flood insurance study for the unincorporated areas. Some cities or towns have their own separate flood insurance study. All of these reports within a given county are available through the respective county floodplain administrator.

Table 2-3 – Flood Insurance Studies

County	Flood Insurance Study Location	Date	Community #	Doc #
Apache	Apache County, Arizona Unincorporated Areas	9/17/1997	040001	040001V000
		9/28/2007	040001	04001CV000A
	City of Saint Johns, Arizona — Apache County	6/16/1993	040010	040010V000
		9/28/2007	040010	04001CV000A
	City of Springerville, Arizona — Apache County	9/28/1990	040011	040011V000
		9/28/2007	040011	04001CV000A
	Town of Eager, Arizona — Apache County	8/19/1991	040103	040103V000
		9/28/2007	040103	04001CV000A
Navajo	Navajo County, Arizona Unincorporated Areas	6/5/1997	040066	040066V000
		11/19/2003	040066	040066V000A
	98-09-379P	3/20/1998	040066	
	99-09-1226P	4/20/2000	040066	
	City of Holbrook, Arizona — Navajo County	3/30/1983	040067	040067V000
	98-09-379P	3/20/1998	040067	
	City of Show Low, Arizona — Navajo County	8/3/1992	040069	040069V000
	Town of Snowflake, Arizona — Navajo County	2/16/1994	040070	040070V000
	Town of Taylor, Arizona — Navajo County	3/2/1994	040071	040071V000
		11/19/2003	040071	040071V000A
	City of Winslow, Arizona — Navajo County	9/30/1992	040072	040072V000
	99-09-443P	4/28/1999	040072	
	Town of Pinetop-Lakeside, Arizona — Navajo County	9/29/1989	040127	040127V000
Gila	Gila County, Arizona Unincorporated Areas	12/4/2007	040028	04007CV001A
	00-09-465P	6/5/2000	040028	
	03-09-187P	9/24/2003	040028	
	City of Globe, Arizona — Gila County	11/1/1979	040029	040029V000
		12/4/2007	040029	04007CV001A

County	Flood Insurance Study Location	Date	Community #	Doc #
	03-09-0187P	9/24/2003	040029	
	Town of Miami, Arizona — Gila County	11/1/1979	040030	040030V000
		12/4/2007	040030	04007CV001A
	Town of Winkelman, Arizona — Gila County	3/1/1979	040031	040031V000
		12/4/2007	040031	04007CV001A
	Town of Hayden, Arizona — Gila County	3/1/1979	040104	040104V000
		12/4/2007	040104	04007CV001A
	Town of Payson, Arizona — Gila County	9/1/1979	040107	040107V000
		12/4/2007	040107	04007CV001A
	00-09-150P	5/18/2000	040107	
	Town of Star Valley, Arizona — Gila County	12/4/2007	040022	04007CV001A
Graham	Graham County, Arizona Unincorporated Areas	7/3/1997	040032	040032V000
		9/28/2007	040032	04009CV000A
	98-09-165P	2/15/2000	040032	
	Town of Pima, Arizona — Graham County	9/28/2007	040033	04009CV000A
	Town of Thatcher, Arizona — Graham County	6/15/1983	040117	040117V000
		9/28/2007	040117	04009CV000A
	City of Safford, Arizona — Graham County	9/28/2007	040124	04009CV000A
Greenlee	Greenlee County, Arizona Unincorporated Areas	9/4/1987	040110	040110V000
		9/28/2007	040110	04011CV000A
	Town of Clifton, Arizona — Greenlee County	9/1/1983	040035	040035V000
		9/28/2007	040035	04011CV000A
	99-09-361P	8/23/1999	040035	
	06-09-B068P	9/26/2006	040035	
	Town of Duncan, Arizona — Greenlee County	2/2/1982	040036	040036V000
		9/28/2007	040036	04011CV000A
Cochise	Cochise County, Arizona Unincorporated Areas	4/2/2003	040012	040012V000
	97-09-111P	1/14/1998	040012	
	98-09-165P	2/15/2000	040012	
	00-09-926P	9/21/2001	040012	
	03-09-1686P	4/29/2005	040012	
	05-09-0689P	1/16/2005	040012	
	06-09-B449P	5/26/2006	040012	
	City of Bisbee, Arizona — Cochise County	7/1/1978	040014	040014V000
	City of Douglas, Arizona — Cochise County	3/29/1978	040015	040015V000
	City of Sierra Vista, Arizona — Cochise County	4/2/2003	040017	040017V000
	06-09-BA33P	3/30/2007	040017	
	City of Wilcox, Arizona — Cochise County	1/17/1978	040018	040018V000
	98-09-165P	2/15/2000	040018	
	02-09-726P	1/27/2003	040018	
	Town of Tombstone, Arizona — Cochise County	8/16/1982	040106	040106V000
Santa Cruz	Santa Cruz County, Arizona Unincorporated Areas	8/23/2000	040090	040090V000
	98-09-010P	9/21/1999	040090	
	05-09-0411P	10/12/2005	040090	
	07-09-1115P	8/13/2007	040090	
	City of Nogales, Arizona — Santa Cruz County	10/15/1980	040091	040091V000
	04-09-0303P	8/16/2005	040091	
	05-09-1233X	8/17/2005	040091	
	Town of Patagonia, Arizona — Santa Cruz County	9/18/1979	040092	040092V000
Coconino	Coconino County, Arizona Unincorporated Areas	9/30/1995	040019	040019V000
	02-09-1336P	1/30/2003	040019	
	02-09-715P	9/25/2002	040019	
	04-09-0997P	1/18/2006	040019	
	07-09-0172P	9/27/2007	040019	
	City of Flagstaff, Arizona — Coconino County	8/2/1996	040020	040020V000

County	Flood Insurance Study Location	Date	Community #	Doc #
	99-09-253P	3/17/1999	040020	
	99-09-432P	3/17/1999	040020	
	99-09-597P	6/4/1999	040020	
	00-09-745P	1/4/2001	040020	
	02-09-715P	9/25/2002	040020	
	04-09-0997P	1/18/2006	040020	
	04-09-1242P	9/15/2005	040020	
	05-09-1103P	3/16/2006	040020	
	Town of Fredonia, Arizona — Coconino County	5/17/1982	040021	040021V000
	City of Williams, Arizona — Coconino County	12/15/1983	040027	040027V000

NOTES:
1) Flood insurance studies per: Arizona Flood Insurance Studies; FEMA Map Service Center (2-CD set)

Impaired and Unique Waters

Section 303(d) of the U.S. Clean Water Act requires states to report a list of all of the state's surface waters that do not meet water quality standards developed by the state and approved by the U.S. Environmental Protection Agency (EPA). Water quality standards vary depending on the designated beneficial "uses" assigned to each water body.

The Arizona Department of Environmental Quality (ADEQ) monitors whether standards are being met and reports the assessment of surface water quality every two years in the Integrated 305(b) Assessment and 303(d) Listing Report. Water bodies where designated uses are not supported because standards are not being met are designated as "impaired." The 303(d) list identifies those impaired waters and notes the pollutants causing the inclusion on the list. Once a surface water body is identified as "impaired," a Total Maximum Daily Load (TMDL) must be developed. A TMDL is the maximum amount of pollutant, such as sediment or metals, a water body can receive and still meet water quality standards. Once a TMDL has been developed, the water body is removed from the 303(d) list and is classified as "nonattaining," meaning that it is not yet attaining the standards to support the designated uses.

The 2006 Draft Integrated 305(b) Assessment and 303(d) Listing Report, including the draft impaired waters and nonattaining waters lists, can be found on the ADEQ website for impaired and unique waters. Table 2-4 lists the impaired and nonattaining surface waters in the three focus areas for this study area.

Arizona's Outstanding Natural Resource Waters (ONRWs) are called "unique waters." Surface waters are designated as unique waters by ADEQ administrative rulemaking when it is decided that the water is an outstanding state resource based on criteria set forth in the Arizona Administrative Code (AAC) Section (§) R18-11-112. A surface water has to be perennial, in a free-flowing condition, have water quality that meets or exceeds applicable water quality standards, and meet one or both of the following: (1) The surface water is of "exceptional recreational or ecological significance," or (2) threatened or endangered species are known to be associated with the water body, and maintenance and protection of existing water quality is essential to the maintenance of the threatened or endangered species, or the surface water provides critical habitat. Site-specific water quality standards may be set for unique waters to further protect water quality within designated segments. Tier 3 antidegradation rules set forth in AAC § R18-11-107(d) do not allow for any level of degradation of water quality in segments designated as unique waters. Currently, there are 19 surface waters designated as unique waters in Arizona, which are shown in Table 2-4 for the three focus areas.

Table 2-4 – Unique and Impaired Waters

Route	Begin MP	End MP	District	Location	Type of Work	Length in Miles	Unique Stream	Impaired Stream
I 010	288.4	291	S	CIENEGA CREEK - MARSH STATION, PHASE III	Remove existing rail & bridge, reconstruct mainline	2.6	Cienega Creek	
I 010	288.4	291	S	CIENEGA CREEK - MARSH STATION	Archaeological investigations and data recovery	2.6	Cienega Creek	
I 010	288.4	291	S	CIENEGA CREEK - MARSH STATION, PHASE I	Railroad grade & drain	2.6	Cienega Creek	
I 010	288.4	290.5	S	CIENEGA CREEK - MARSH STATION, PHASE II	New railroad tracks	2.1	Cienega Creek	
I 010	288.6	288.8	S	PANTANO RR UP/CIENEGA CREEK SECTION	Construct Structure	0.2	Cienega Creek	
I 010	303.69	307.9	S	BENSON BYPASS	Mill 2" & (RR 4" TL, 3" PL) & ARFC	5.33		San Pedro River
I 010	303.69	307.9	S	BENSON BYPASS	Mill 2" & (RR 4" TL, 3" PL) & ARFC	5.33		San Pedro River
I 015	9	9	F	FARM ROAD TI	Construct new underpass	0.1		Virgin River
I 019	0	6	T	INTERNATIONAL BORDER TO JCT B-19	RR (4" TL, 2" PL) & 2" AC & 1/2" ARFC	6		Nogales Wash
I 019	4.9	0	T	COUNTRY CLUB RD TO RUBY RD, W FRONTAGE RD	Design Frontage Rd	4.9		Nogales Wash
S 082	0	0.1	T	PATAGONIA LAKE (SONOITA CREEK)	Design	0.1		Nogales Wash
U 060	230	260	G	SUPERIOR TO GLOBE	Design Concept Report/Environmental Impact Statement	0		Pinto Creek
U 060	236.2	239.5	G	COUNTY LINE - PINTO VALLEY	RR 3" + ARFC & passing lane	3.3		Pinto Creek
U 060	236.2	239.5	G	COUNTY LINE - PINTO VALLEY	RR 3" + ARFC & passing lane	3.3		Pinto Creek
U 191	175	225	S	CORONADO TRAIL	District Force Account	50	K P Creek	
U 191	175	225	S	CORONADO TRAIL	District Force Account	50	K P Creek	
U 191	151	154.2	S	MP 151 - THREEWAY	Construct Roadway & Bridge Approaches	3.2		Gila River
U 191	151	154.2	S	MP 151 - THREEWAY	Construct Roadway & Bridge Approaches	3.2		Gila River

Sole Source Aquifers

The EPA defines sole source aquifers as a sole or principal drinking water source. Sole source aquifers that occur within the study area are the Upper Santa Cruz River and Avra Basin aquifers and the Bisbee-Naco Aquifer. Many of the aquifers within the study area are by definition sole source aquifers; however, they have not been designated as such. EPA's source water aquifer protection and wellhead protection program provides protection versus designation. Wellhead protection is voluntary, but all states are required to have a source water aquifer protection program. In Arizona, all aquifers are classified as drinking water aquifers, which are described in detail below.

Groundwater

A significant amount of hydrological resource information is available from the ADWR Arizona Water Atlas (2006–2008, Draft). ADWR's water atlas provides a comprehensive overview of regional water supply and demand conditions, and provides water resource information for planning and resource development purposes on a statewide basis. The atlas divides the state into seven planning areas. For each planning area, ADWR has compiled information on geography, land ownership, hydrogeology, climate, environmental conditions, population, water supply, cultural water demand, surface water conditions, water quality conditions, streams and springs, assured or adequate water supply determinations, and water resource issues (ADWR 2006).

The three focus areas occupy parts of four ADWR planning areas. From north to south, these planning areas are: (1) the Eastern Plateau Planning Area, (2) the Central Highlands Planning Area, (3) the Southeastern Arizona Planning Area, and (4) the Active Management Planning Area. Each ADWR planning area is composed of groundwater basins.

The focus areas are located in relation to the ADWR planning areas as follows:

- The ***Mogollon Rim Focus Area*** straddles the Eastern Plateau and the Central Highlands planning areas.
- The ***Copper Country Focus Area*** includes the southeast part of the Central Highlands Planning Area and the northern part of the Southeastern Arizona Planning Area.
- The ***Cochise-Santa Cruz Focus Area*** includes the southern half of the Southeastern Arizona Planning Area and a small part of the Active Management Planning Area in Santa Cruz County.

Table 2-5 is a list of the groundwater basins within ADWR's planning areas for the three focus areas.

Table 2-5 – Groundwater Basins in ADWR Planning Areas

	Eastern Plateau Planning Area	Central Highlands Planning Area	Southeastern Arizona Planning Area	Active Management Planning Area
Mogollon Rim Focus Area	▪ Little Colorado River Plateau	▪ Salt River ▪ Verde River ▪ Tonto Creek		
Copper Country Focus Area		▪ Salt River ▪ Bonita Creek	▪ Morenci ▪ Duncan Valley ▪ Aravaipa Canyon ▪ Dripping Springs Wash ▪ Safford ▪ Lower San Pedro ▪ Willcox	
Cochise-Santa Cruz Focus Area			▪ Lower San Pedro ▪ Willcox ▪ Safford ▪ Upper San Pedro ▪ Douglas ▪ San Bernandino Valley ▪ Cienega Creek ▪ San Raefael	▪ Tucson Active Management Area ▪ Santa Cruz Active Management Area

SOURCE: Arizona Department of Water Resources
NOTE: ADWR = Arizona Department of Water Resources

Groundwater Basins – Mogollon Rim Focus Area

Water-Bearing Formations of the Little Colorado River Plateau Basin

There are several local aquifers and one regional aquifer that contain large amounts of groundwater in storage in the Little Colorado River Basin. The C-aquifer is the largest and most productive aquifer in the area. It is named for its primary water-bearing unit, the Coconino Sandstone. Main recharge areas are along the southern and eastern periphery of the planning area. This C-aquifer is used as a supply south of the Little Colorado River and along the eastern edge of the basin by the communities of Heber, Overgaard, Show Low, Snowflake, and Concho. North of the river, the C-aquifer is too deep to be economically useful or is unsuitable for most uses because of high concentrations of total dissolved solids. ADWR estimated that 413 million acre-feet of water are stored in the aquifer overall (ADWR 1989, 2006).

The Bidahochi Formation creates a local aquifer in the central part of Apache and Navajo counties south of the community of Sanders. In the southeastern part of Navajo County, saturated basaltic rocks, together with underlying sedimentary rocks, are locally known as the Lakeside-Pinetop Aquifer, which is an important supply for the area. Undifferentiated sandstones west of Show Low along the Mogollon Rim and in the Springerville-Eager area form aquifers that are also locally important supplies (ADWR 2006).

Water-Bearing Formations of the Verde River Basin

Major aquifers in the basin include the Verde Formation, recent stream alluvium, basin-fill carbonate aquifers, and igneous and metamorphic rock. In the Mogollon Focus Area, groundwater occurs within the Verde Valley and Verde Canyon subbasins:

- **Verde Valley Subbasin:** The portion of the Mogollon Focus Area that occurs within the Verde Valley subbasin primarily includes consolidated crystalline and sedimentary rocks. Flow direction is generally from the north to the south following the Verde River. Recharge in the Verde Valley subbasin is principally from infiltration of precipitation in the higher elevations (ADWR 2007).

- **Verde Canyon Subbasin:** The Verde Canyon subbasin includes the communities of Strawberry, Pine, and Payson and also consists of consolidated crystalline and sedimentary rocks. The deepest recorded water level in the basin was 1,375 feet, documented in the vicinity of Strawberry (ADWR 2007).

Water-Bearing Formations of the Tonto Creek Basin

The Tonto Creek Basin includes the communities of Punkin Center, Rye, Star Valley, and Kohls Ranch. The major aquifers in the basin are basin fill and sedimentary rock (C- and R-aquifers). Most of the basin geology consists of consolidated crystalline and sedimentary rocks. Flow direction is generally from the north to the south.

Well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm. One source of well yield information, based on 51 reported wells, indicates that the median well yield in this basin is 120 gpm. The highest well yields in the basin are located along US Highway 188 north of Punkin Center.

There are two estimates of natural recharge for this basin ranging from 17,000 acre-feet per year to 37,000 acre-feet per year. There are three estimates of water in storage for this

basin ranging from 2 million acre-feet to 9.4 million acre-feet. The most recent estimate, from a 1994 ADWR study, is 3 million acre-feet of water in storage to a depth of 1,200 feet.

The deepest recorded water level in the basin is 106 feet, documented east of Kohls Ranch, and the shallowest is 14 feet near Punkin Center (ADWR 2007).

Water-Bearing Formations of the Salt River Basin

Major aquifers in the basin include recent stream alluvium, volcanic rock (Pinetop-Lakeside Aquifer), and sedimentary rock (Gila Conglomerate, and C- and R-aquifers). Most of the basin geology consists of consolidated crystalline and sedimentary rock. The basin contains four subbasins and includes, from east to west, the northern half of the Salt River Lakes subbasin, most of the Salt River Canyon subbasin, the Black River subbasin and the White River subbasin.

Flow directions are generally not available due to the consolidated nature of the basin geology. Groundwater flow in the C-aquifer in the northwestern portion of the basin is from north to south.

Well yields in this basin range from less than 100 gpm to greater than 2,000 gpm. One source of well yield information, based on 140 reported wells, indicates that the median well yield in this basin is 170 gpm. Well yields vary throughout the basin, with the lowest and the highest well yields found in the Globe-Miami area in unconsolidated sediments.

The estimate of natural recharge for this basin is 178,000 acre-feet per year. There is one estimate of water in storage for this basin. This estimate, from a 1992 ADWR study, indicates the basin has more than 8.7 million acre-feet of water in storage to a depth of 1,200 feet.

All water-level information is from the western portion of the basin. The deepest recorded water level is 82 feet and the shallowest is 8 feet, both located north of Miami-Globe (ADWR 2007).

Groundwater Basins – Copper Country Focus Area

Water-Bearing Formations of the Salt River Basin

The southern part of the Salt River Lakes, the White River subbasin, and all of the Black River subbasin of the Salt River Basin are located within the Copper Country Focus Area. Generalized hydrologic conditions for the Salt River Basin are described above under the Mogollon Focus Area.

Water-Bearing Formations of the Bonita Creek Basin

Major aquifers in the basin include recent stream alluvium, basin fill, and volcanic rock. Flow direction is generally from the northwest to the southeast of the basin. Well yields in this basin range from less than 100 gpm to 2,000 gpm. Reported well yield information indicates that the median well yield in this basin is 1,144.5 gpm, but the average may be lower. Natural recharge for this basin has been estimated at 9,000 acre-feet per year.

There are three wells with water depth reported in 2003-2004. Water-level change data are not available. All wells are in the same area, near Bonita Creek, and the depth to water ranges from 4 feet to 12 feet (ADWR 2007).

Water-Bearing Formations of the Morenci Basin

The major aquifers in this basin are recent stream alluvium and volcanic rock. Flow direction is generally from north to south. Well yields in this basin range from less than 100 gpm to more than 2,000 gpm. One source of well yield information, based on 53 reported wells, indicates that the median well yield in this basin is 600 gpm. Natural recharge has been estimated at 15,000 acre-feet per year from a 1986 Freethey and Anderson study (ADWR 2007).

The deepest recorded water level in the basin is 78 feet, and the shallowest is 8 feet in 2003-2004. All recorded water-level changes are in the vicinity of Alpine. Of the three recorded wells in the basin, the water level in one has decreased between 1 and 15 feet, one has increased between 15 and 30 feet, and the third lacks change data (ADWR 2007).

Water-Bearing Formations of the Duncan Valley Basin

The major aquifers in the basin are recent stream alluvium, consisting of gravel and sand underlain by clay, and Gila Formation sedimentary rock, consisting of poorly consolidated sand, silt, and gravel. The principal source of groundwater is the recent stream alluvium. Flow direction is generally from the south to the northwest. Well yields in this basin range from less than 100 gpm to more than 2,000 gpm. One source of well yield information, based on 160 reported wells, indicates that the median well yield in this basin is 850 gpm.

There are natural recharge estimates for this basin ranging from 6,000 acre-feet per year to 14,200 acre-feet per year (ADWR 1994). There are three storage estimates for this basin ranging from 9 million acre-feet to 19 million acre-feet to a depth of 1,200 feet. The latter, from the 1994 ADWR study, is the most recent.

Depth to water varies in this basin, with the deepest recorded water level measured during 2003-2004 at 504 feet at the northwestern basin boundary and the shallowest at 21 feet in the vicinity of Duncan. All recorded wells in this basin have declined between 1 and 15 feet between 1990-1991 and 2003-2004 (ADWR 2007).

Water-Bearing Formations of the Aravaipa Basin

Major aquifers in the basin include recent stream alluvium and basin fill. The recent stream alluvium is the primary source of water in the basin. Flow direction is generally from southeast to northwest.

Well yields in this basin range from less than 100 gpm to 2,000 gpm. One source of well yield information, based on 36 reported wells, indicates that the median well yield in this basin is 350 gpm. The highest reported well yields in the basin are located in unconsolidated sediments in the vicinity of the Klondyke and Klondyke-Bonita roads.

Principal sources of recharge are mountain-front recharge, streambed infiltration of runoff, and direct infiltration of rainfall. Natural recharge estimates range from 7,000 acre-feet per year to 16,700 acre-feet per year. The most recent estimate is from a 1994 ADWR study. Storage estimates for this basin range from 5 million to 5.1 million acre-feet to a depth of 1,200 feet.

There are two wells with water depth reported in 2003-2004. The wells are along the Klondyke and Klondyke-Bonita roads and measure 39 feet and 64 feet to water (ADWR 2007).

Water-Bearing Formations of the Safford Basin

The Safford Basin is composed of three subbasins. Within the Copper Country Focus Area, the northern subbasin, the San Carlos Valley subbasin, consists of younger stream alluvium and basin fill. The principal water-bearing unit is the younger stream alluvium. The middle subbasin, the Gila Valley subbasin, contains older and younger basin fill. The principal aquifer is the younger basin fill. Flow direction is generally from south to north; however, the flow is from north to south in the vicinity of San Carlos. Flow directions have been altered due to pumping south of I-10.

Well yields in this basin range from less than 100 gpm to more than 2,000 gpm. ADWR reports that one source of well yield information, based on 1,494 reported wells, indicates that the median well yield in this basin is 600 gpm.

The only estimate for natural recharge the entire basin is 105,000 acre-feet per year, from a 1986 Freethey and Anderson study. There are three storage estimates for the Safford Basin ranging from more than 27 million acre-feet to 69 million acre-feet. The most recent estimate, from a 1990 ADWR study, is 66 million acre-feet to a depth of 1,200 feet.

Shallow water levels are found in the Safford, Pima, and Thatcher area, with water levels as shallow as 21 feet. Change in water level ranges from decreases greater than 30 feet to increases of as much as 30 feet between 1990-1991 and 2003-2004. Most of the measured wells in the vicinity of Pima, Thatcher, and Safford show water-level declines between 1 and 15 feet (ADWR 2007).

Water-Bearing Formations of the Dripping Springs Wash Basin

The eastern half of Dripping Springs Wash, east of the Gila River in Pinal and Graham counties, is located within the Copper Country Focus Area. The major aquifers in the basin are recent stream alluvium, consisting of mostly sand and silt, and Gila Conglomerate sedimentary rock. The recent stream alluvium is the principal water-producing unit. Flow direction is generally from the northwest to the southeast. Well yields in this basin range from less than 100 gpm to 2,000 gpm.

The most recent estimate, from a 1994 ADWR study, indicates the basin has 1.3 million acre-feet of groundwater in storage to a depth of 1,200 feet. Wells in the area near Bonita Creek have depths to water that range from 4 feet to 12 feet (ADWR 2007).

Groundwater Basins – Cochise-Santa Cruz Focus Area

In ADWR's Arizona Water Atlas, the Southeastern Arizona Planning Area is generally characterized by alluvial basins with large reserves of groundwater in gently sloping valleys separated by mountain ranges. The alluvial basins of south-central Arizona have been divided into five groups based on similar hydrologic and geologic characteristics (Anderson, Freethy and Tucci 1992). The principal water-bearing deposits in southeast basins are moderately thick sediments deposited prior to the formation of the basin and range structure and an overlying layer of lower basin fill to depths of over 1,000 feet, derived from the subsequent partial erosion of the ranges. Lower basin-fill sediments are composed of fine-grained to moderately fine-grained materials. Upper basin-fill deposits average about 300 feet in thickness and are composed of sands, gravels, silts, clays, and some limestones.

Water-Bearing Formations of the Lower San Pedro Basin

Major aquifers in the basin include basin fill, consisting of younger basin fill, older basin fill and basal conglomerate, and recent stream alluvium. Within the Lower San Pedro Basin, artesian conditions exist primarily in the vicinity of Benson. The groundwater flow direction is generally from southeast to northwest, following the San Pedro River.

Well yields vary throughout the basin and range from less than 100 gpm to more than 2,000 gpm. Well yield information, based on 353 reported wells, indicates that the median well yield in this basin is 600 gpm (ADWR 2007). Recharge in the Lower San Pedro Basin is principally from mountain-front recharge and streambed infiltration. There are three natural recharge estimates for this basin, ranging from 24,000 acre-feet per year to 29,000 acre-feet per year (Anderson and Freethey 1995). There are also four storage estimates for this basin ranging from 19.8 million to 59 million acre-feet. The most recent storage estimate, from a 2005 ADWR study, is between 19.8 million and 26.1 million acre-feet to a depth of 1,200 feet (ADWR 2007).

Deep water levels are found in the vicinity of Sierra Vista with water levels as deep as 585 feet measured by ADWR in 2003-2004. Shallow water levels are found near the Mexican border in the vicinity of US Highway 92 with levels as shallow as 10 feet in 2003-2004. Change in water levels varies across the basin from a 15-foot increase to a more than 30-feet decrease. In general, declines of 1 to 15 feet were observed in the Sierra Vista and Benson areas (ADWR 2007).

Water-Bearing Formations of the Wilcox Basin

Major aquifers in the basin include recent stream alluvium from stream and lakebed deposits and basin fill. The Willcox Basin is a “closed basin” with no interbasin groundwater inflow or outflow. Groundwater flow conditions have been altered significantly in several locations due to groundwater pumping. Historically, flows were from the perimeter of the Sulphur Springs Valley toward the Willcox Playa.

The Wilcox Basin provides well yields ranging from less than 100 gpm to more than 2,000 gpm. Well yields vary throughout the basin; well information indicates that the median well yield in this basin is 750 gpm.

There are three estimates of natural recharge for this basin, ranging from 15,000 acre-feet per year to 47,000 acre-feet per year (Anderson and Freethey 1995). There are also three storage estimates for the Wilcox basin, ranging from 42 million acre-feet to 59 million acre-feet. The most recent estimate of water in storage is between 42 million and 45.3 million acre-feet to a depth of 1,200 feet (ADWR 1990, 1994).

The depth to water varies in this basin, with the deepest recorded water level in 2003-2004 being 431 feet in the vicinity of US Highway 191, near the southern basin boundary, and the shallowest recorded water level in 2003-2004 being 36 feet in the vicinity of Willcox. All reported wells in this basin have declines of at least 1 foot, and a number of wells show water-level declines greater than 30 feet (ADWR 2007).

Water-Bearing Formations of the Upper San Pedro Basin

Major aquifers in this basin include basin fill, consisting of younger basin fill, older basin fill and basal conglomerate, and recent stream alluvium. The basin fill is the principal aquifer, although the stream alluvium is also used. Within the Upper San Pedro Basin, artesian

conditions exist primarily in the vicinity of the City of Benson. The groundwater flow direction is generally from south to north, following San Pedro River to the Gila River.

The Upper San Pedro Basin provides well yields ranging from less than 100 gpm to more than 2,000 gpm. Well yields vary throughout the basin; well information indicates that the median well yield in this basin is 600 gpm.

Recharge in the Upper San Pedro Basin is principally from mountain-front recharge and streambed infiltration. The most recent natural recharge estimate is 35,750 acre-feet per year (ADWR 2005). There are four storage estimates for this basin, ranging from 19.8 million to 59 million acre-feet. The most recent estimate is between 19.8 million and 26.1 million acre-feet to a depth of 1,200 feet (ADWR 1995).

The depth to water varies in the Upper San Pedro Basin; deep water levels are found near the City of Sierra Vista, with water levels as deep as 585 feet measured in 2003-2004. Shallow water levels are found near the Mexican border in the vicinity of US Highway 92, with levels as shallow as 10 feet recorded in 2003-2004. Change in water levels varies across the basin from a 15-foot increase to a more than 30-foot decrease. In general, declines of 1 to 15 feet were observed in the Sierra Vista and Benson areas (ADWR 2007).

Water-Bearing Formations of the San Bernardino Basin

Major aquifers in the San Bernardino Basin consist of recent stream alluvium and volcanic rock. Within the Cochise–Santa Cruz Focus Area, artesian wells and springs support wetlands in this basin near the border with Mexico. Within the San Bernardino Basin, the groundwater flow is generally from north to south, following the Cottonwood Draw stream and towards the Black Draw stream.

The San Bernardino Basin provides well yields ranging from less than 100 gpm to 1,000 gpm. Well information indicates that the median well yield in this basin is 450 gpm; however, the range is quite large, varying from 22 to 600 gpm.

The only natural recharge estimate for this basin is 9,000 acre-feet per year (Freethey and Anderson 1986). There are two storage estimates of 1.6 million acre-feet and 2 million acre-feet to a depth of 1,200 feet.

The depth to water in the San Bernardino Basin varies from 612 feet in this north-central portion to 30 feet along its border with Mexico. Two well-water levels have fluctuated between a 1-foot decline and a 1-foot increase, and the third well lacks change data for the period between 1990-1991 and 2003-2004 (ADWR 2007).

Water-Bearing Formations of the San Rafael Basin

Major aquifers in the basin include recent stream alluvium (composed of well-sorted silt, sand, and gravel) and basin fill consisting of clay, silt, sand and gravel. The streambed alluvium and the basin fill are hydrologically connected. Within the San Rafael Basin groundwater flow is generally from north to south toward the Santa Cruz River.

The San Rafael Basin contains well yields ranging from less than 100 gpm to 1,000 gpm. Well information indicates that the median well yield in this basin is 145 gpm.

Recharge in the San Rafael Basin is principally from mountain-front recharge and infiltration from runoff in washes. The only natural recharge estimate for this basin is 5,000 acre-feet

per year (Freethey and Anderson 1986). There are two storage estimates of 5 million acre-feet and 4 million acre-feet to a depth of 1,200 feet.

The depth to water in the San Rafael Basin varies; the deepest recorded water level in 2003-2004 was noted 205 feet northwest of Lochiel, and the shallowest was 6 feet northeast of Lochiel. Most well-water levels have declined between 1 and 15 feet between 1990-1991 and 2003-2004. The water level in one well has increased between 1 and 15 feet during the same period (ADWR 2007).

Water-Bearing Formations of the Cienega Creek Basin

Major aquifers in the basin include recent stream alluvium and basin fill. The basin consists of three groundwater sections, upper Cienega Creek, lower Cienega Creek, and Sonoita Creek. In the central valley, in the upper Cienega Creek section, the principal aquifer consists of basin-fill alluvium. From "the Narrows" south of I-10, where the central valley narrows to the northern basin boundary in the lower Cienega Creek section, there are three aquifers: stream alluvium, basin fill, and the Pantano Formation. The main aquifer in this section is the stream alluvium. In the southwestern portion of the basin, in the Sonoita Creek section, the main aquifer is the stream alluvium that forms the floodplain of Sonoita Creek and its tributaries. Flow direction south of the community of Sonoita is generally from north to southwest toward Sonoita Creek, and north of Sonoita the flow is from southwest to northeast toward Cienega Creek.

The Cienega Creek Basin provides well yields ranging from less than 100 gpm to 2,000 gpm. Well yields vary throughout the basin; well information indicates that the median well yield in this basin is 250 gpm.

There are two natural recharge estimates for this basin, 11,000 acre-feet per year and 8,500 to 25,500 acre-feet per year (ADWR 1994). Within the Cienega Creek Basin, there are three storage estimates for this basin, ranging from 5.1 million acre-feet to 11 million acre-feet. The most recent estimate indicates the basin has 5.1 million acre-feet of water in storage to a depth of 1,200 feet (ADWR 1994).

The depth to water in the Cienega Creek Basin varies. The deepest recorded water level in 2003-2004 was 207 feet in Sonoita, and the shallowest was 21 feet near Elgin (ADWR 2007).

Water-Bearing Formations of the Douglas Basin

Major aquifers in the Douglas Basin are basin fill and basin fill with interbedded volcanic rock, located in the Douglas area. Near the community of Elfrida, groundwater flow directions have been altered due to agricultural pumpage. Within the Douglas Basin, groundwater flow is generally from north to south and east to west south of Elfrida.

The Douglas Basin provides well yields ranging from less than 100 gpm to more than 2,000 gpm. Well yield information indicates that the median well yield in this basin is 600 gpm. In general, the highest well yields are north of Elfrida and west of Pirtleville. All well yields in the vicinity of Bisbee are less than 100 gpm.

Recharge in the Douglas Basin is principally from mountain-front precipitation. There are three natural recharge estimates for this basin, ranging from 15,500 acre-feet per year to 22,000 acre-feet per year. The most recent estimate is 15,500 acre-feet per year and is from 1995. There are also three storage estimates for this basin, ranging from 26 million

acre-feet to 32 million acre-feet. The most recent estimate indicates the basin has 32 million acre-feet of water in storage to a depth of 1,200 feet (ADWR 1994, 2007).

Water-Bearing Formations of the Safford Basin

The Safford Basin is composed of three subbasins. The San Carlos subbasin, previously described, is located in the Copper Country Focus Area. The two subbasins in the Cochise-Santa Cruz Focus Area are as follows:

- **San Simon Subbasin:** The southernmost subbasin, the San Simon Valley subbasin, consists of recent stream alluvium and contains artesian conditions in the lower aquifer.
- **Gila Valley Subbasin:** The middle subbasin, the Gila Valley subbasin, contains older and younger basin fill. The principal aquifer is the younger basin fill.

The groundwater flow direction in the Safford Basin is generally from south to north. The Safford Basin contains well yields ranging from less than 100 gpm to more than 2,000 gpm. Deep water levels are found in the vicinity of I-10 with water levels reaching as deep as 517 feet. Change in water levels ranges from decreases greater than 30 feet to increases of as much as 30 feet between 1990-1991 and 2003-2004 (ADWR 2007).

Drainage Studies

The ADOT Drainage Group would provide existing drainage studies associated with the predesign stages (see Table 2-6, Drainage Studies), which could include Location/Design Concept Reports (L/DCR), Design Concept Reports, and Feasibility Reports. When a DCR is in the initial stages, the drainage engineer must consult with the ADOT Drainage Group leader for the most current list and request copies of available drainage reports.

All the counties within the focus areas were contacted to determine what (if any) of the following levels of drainage studies were available (see Table 2-6, Drainage Studies):

- Area Drainage Master Studies (ADMS)
- Area Drainage Master Plans (ADMP)
- Watercourse Master Plans (WMP)
- Geomorphological studies

Should ADMS become available, they would be useful to identify areas with a history or high risk of flooding and to coordinate the location of potential roadway corridors to avoid potential FEMA and U.S. Army Corps of Engineers Section 404 permitting issues. The ADMPs could be used to learn of the county-funded, long-range drainage projects and the coordinate placement and sizing of ADOT drainage facilities accordingly. WMPs and geomorphological studies generally apply to a single river or major streambed.

Table 2-6 – Drainage Studies

Route #	Project No.	(File Number) Updated (6/18/03)	M.P.	Loc	Date	Remarks
10	IM-10-5 (68)		288	DDS	34182	CIENEGA CREEK WATERSHED HYDROLOGIC ANALYSIS - MARSH STATION TI
10	XB-511-331	511-331 (PE)	297	DDS	30103	DRAINAGE STR REVIEW
10		10-5(68)	300	DDS		CINEGA CREEK BRIDGE (HYDROLOGY)
10	I-10-6(14)	10-6(41)	303.2	10.5	26665	BENSON FREEWAY
10	I-10-6(14)	10-6(46)	306.7	10.58	25416	SAN PEDRO RIVER
10	I-10-2(57)	10-6(60)	316.1	10.62	26665	TEXAS CYN-COCHSE TI
10	I-10-6(68)	10-6(70)	320.3	10.74	28399	TEXAS CANYON
10	I-10-6(22)	10-6(28)	336.2	DDS	Feb-84	WILCOX FLOOD 1983
10	I-10-F(002)B		340	DDS	Mar-05	FORT GRANT ROAD TI
10	I-10-6(49)	10-6(50)	343.7	10.56	Jan-74	WILLCOX-LUZENA
10		10-4(170)	FrontRd	DDS	Apr-99	FRONTAGE ROADS(INA-RUTHRAUF)
10	I-10-3(182)	10-3(182) (PE)	LOOP	DDS	Jun-84	PUMP SYSTEMS DESIGN
10		10-3(187)	LOOP	DDS	Dec-83	CULVER ST. TUNNEL
19	I-19-1(33)	19-1(35)	0	10.73	Jan-71	NOGALES INT FREEWAY
19		ER-19-1(82)C	0.1	DDS	Mar-78	AGUA FRIA WASH BRIDGE HYDRAULIC REPORT
19	XB-511-211	511-211 (PE)	2	DDS	Jul-80	MARIPOSA CYN UTILITS
19		I19-1(407)	4.9	DDS	Dec-87	COUNTRY CLUB GS - POTRERO CREEK, WEST FRONTAGE ROAD
19		ER-19-1(90)	12	DDS	Jan-84	AGUA FRIA CANYON WASH FLOOD REPAIRS
19		19-1(916)	12	DDS	May-81	AGUA FRIA CANYON PROTECTION
19		19-1(98)	14.4	MICRO	Oct-83	PECK CANYON
19	I-19-1(23)	19-1(25)	16	10.72	Jan-76	OTERO-CARMEN
19		19-1(92)	17.5	MICRO	Nov-85	ARROYO ANGULO AGUDO
19	I-19-1(27)	19-1(29)	21.3	10.72	Jan-79	TUBAC SECTION
19	I-19-1(30)	19-1(32)	25.2	10.74	May-75	AMADO SECT VOL 1-3
19		19-1(94)	29.7	MICRO	Mar-84	SOPORI WASH BRIDGES
19		19-1(96)	31	MICRO	May-84	OLD JCT WASH DMG
19		19-1(96)	31.1	MICRO	Mar-84	TINAJA WASH FLD DMG
19	I-19-1(39)	19-1(41)	31.5	10.65	Jan-77	CANOA RANCH SECTION
19		19-1(95)	36.1	MICRO	May-84	ESPERANZA FLD DMG
19		19-1(511)	36.7	DDS	May-93	2-CBC'S
19	I-19-1(42)	19-1(5),(7)	36.8	10.54	Jan-75	CANOA RCH-SN XVR TI
19	I-19-1(42)	19-1(44)	39.8	10.65	Jan-77	GREEN VALLEY SECTN
19		19-1(918)	41.8	DDS	Oct-81	GREEN VALLEY CHNLZTN
19	019-A-400	Tracs #H5104 03D	42	DDS	Feb-04	I-19 / DUVAL MINE RD TI
19	I-19-1(11)	19-1(13)	42.2	10.65	Jan-71	DUVAL TI-SAHRITA RD
19	ER-019-A-(005)A	ER-019-A-(005)A	54.78	DDS	Oct-02	MP 54.78 DROP STRUCTURE, SCOUR ANALYSIS AND RIPRAP SIZING
19	ER-19-1(91) and ER-19-1(97)		56.6	DDS	Jul-85	SANTA CRUZ FLOOD DAMAGE AT I-19 AND SAN XAVIER MISSION RD
19		NH-19-1(111)	58	DDS	Mar-99	VALENCIA TI / VOL. 1 & 2
19	ER-19-1(90), (94), (95) & (96)		VAR	DDS	Mar-84	BANK PROTECTION STUDY, AGUA FRIA CANYON, SOPORI, TINAJA, OLD JCT AND ESPERANZA WASHES
19		19-1(83)		MICRO	Apr-84	SANTA CRUZ REPAIR
60	RAM 060-B-503		149	DDS	Mar-01	GRAND AVE, 91ST AVE RAMPS TO THE AGUA FRIA FREEWAY
60		26-1(19)	292.9	DDS	Aug-85	SALT RIVER CANYON
60	F-026-1-418	26-1(18)	315.6	10.67	Jan-77	CARRIZO CRK SECTION
60		26-1(41)	320.62	DDS	Oct-99	HAGEN HILL
60		26-1(933)	322.7	DDS	Jul-87	CEDAR CANYON BRIDGE

Route #	Project No.	(File Number) Updated (6/18/03)	M.P.	Loc	Date	Remarks
60		26-1-933	322.7	MICRO	Mar-71	CEDAR CANYON HYDROLOGY STUDY
60	F-026-1-816	26-1(16)	325.1	10.75	Jan-78	CORDUROY CYN SECTN
60		26-1(416)	325.1	10.76A	Jan-84	CORDUROY CYN SECT
60		26-1(932)	327.6	DDS	Jul-87	CORDUROY CYN BRIDGE
60	F-026-1(310)	26-1(510)	339.5	10.74	Jun-78	SHOW LOW STREETS
60	F-026-2-308	26-2(509)	348.4	DDS	Apr-79	REPLACEMENT CULVERT
60		26-2(12)	352.3	DDS	Aug-93	US 60
60	F-026-2-404	26-2(4)	352.6	MICRO	Dec-85	ORTEGA WASH BRIDGE
60	F-026-2-305	26-2(505)	358.7	10.57	Jan-75	SHOWLOW-SPRNGVILLE
60		26-2(10)	360.9	DDS	Jul-92	SEPULVEDA WASH
60		26-2(4)	360.94	DDS	Sep-80	SEPULVEDA WASH PREL. DRAINAGE CALCULATIONS
60		26-2(11)	365.2	DDS	Jul-92	BUTLER RANCH #4167
60		26-2(528)	367	DDS	Jun-00	WILDCAT WASH BRIDGE, NO 181 WIDENING
60	BR-060-F-004		371	DDS	Dec-05	MALLORY DRAW BRIDGE
60	F-028-311	28-(611)	16(SR360)	DDS	Feb-87	SUPERST. OFFSITE DR.
60	060-B-500	60-B-500		DDS	Apr-01	GRAND AVE. OVERPASS AT 43RD AVE AND CAMELBACK RD
60	SBM-022-2-301	22-2-301 (PE)		DDS	Jun-88	GRAND AVENUE WIDENING
60	STP-060-C(001)B	STP-060-C(001)B		MICRO	Feb-02	US-60 HOV WIDENING, I-10 TO VAL VISTA DR
60		4053-6083		DDS	Jun-86	RWCD CROSSING AT JCT. OF HIGLEY RD. AND US 60
70	H5916 01C		251	DDS	Mar-03	MCMILLEN WASH TO SR 77, SEGMENT I
70	STP-TEA-070-A(006)A	70-A(006)A	252.8	DDS	Jan-03	US 60/70: MCMILLEN WASH - JCT US 70/SR 77, SEGMENT II, CRESTLINE DR TO SR 77
70	F-022-4-555	22-4-555	271	DDS	Jul-01	US-70, MP 271
70		22-4(24)	293	DDS	Sep-84	GILA RIVER BRIDGE AT BYLAS
70	BR-022-4(43)	22-4(43)	301.85	DDS	Feb-01	GOODWIN WASH BRIDGE #2736
70	F-022-4-311	22-4(511)	330.8	10.57	Jan-75	STREETS OF PIMA
70		22-4-440	336.5	DDS	Jan-02	PIMA TO THATCHER (VOL 1) AND THATCHER TO SAFFORD (VOL 2)
70		22-4(30)	385	DDS	Oct-91	SAFFORD-LORDSBURG
73		215-(5) P	319	DDS	Aug-00	CEDAR CREEK BRIDGE
73	S-215-305	215-(505)	327.4	10.52	Jan-72	AMOS WASH BRIDGE
73		215-(310)	337.5	DDS	Jul-92	WHITERIVER STREETS
73	S-215-307	215-(507)	340.8	10.75	Jan-78	WHITE R.-MINING CYN
80	F-016-1-430	16-1-430	293.6	DDS	Jan-01	BENSON-DOUGLAS HWY + ADDENDUM #1 AND APPENDICES 7.1 & 7.2
80	F-016-1-430	16-1-430	293.6	DDS	Jun-98	BENSON-DOUGLAS HWY - ADDENDUM - HYDRAULIC STUDY & BANK PROTECTION
80		16-1(921)	305.8	DDS	Aug-85	CULVERT SCOUR PROT
80	F-016-1-308	16-1(508)	343.6	10.75	Jan-83	LOWELL CIRCLE
80		16-1-534	343.98	DDS	Oct-98	MULE PASS BRIDGE #0290, HYDROLOGIC AND HYDRAULIC ANALYSES
80	F-016-1-314	16-1(514)	351	10.75	Jan-78	BISBEE-COCHISE JCT
80	F-016-1-417	16-1(18)	357.5	10.57	Jan-76	COCHISE JC-DOUGLAS
80	F-016-1-417	16-1(17)	361.6	10.6	Jan-76	COCHISE JC-DOUGLAS
80	CBI 080-A(009)	80-A(009)	364	DDS	Aug-06	DOUGLAS STRATEGIC MOTOR CARRIER WEIGH AND SAFETY INSPECTION STATION
80	S 080-A-301	80-A-301	364	DDS	Aug-06	SR 80 / US 191 INTERSECTION
80		16-1-332	365.97	DDS	Mar-99	CITY OF DOUGLAS, 11TH STREET TO LESLIE CANYON RD.

Route #	Project No.	(File Number) Updated (6/18/03)	M.P.	Loc	Date	Remarks
80	F-016-1-417	16-1(19)	366.2	10.74	Jan-73	DOUGLAS WEST END
80		16-1(508)		10.76A	Jan-73	JCT SR 80-SR 92
80	F-016-1-309	16-1-509		MICRO	Jun-71	BENSON-DOUGLAS HWY., LAVENDER PIT - LOWELL
80	F-016-1-430	16-1-430		DDS	Jan-01	MOBILE HOME PARK ENTRANCE, BENSON-DOUGLAS HWY
80	F-016-1-430	16-1-430		DDS	Jan-01	MOBILE HOME PARK ENTRANCE, BENSON-DOUGLAS HWY APPENDIX 7.1
80	F-016-1-430	16-1-430		DDS	Jan-01	MOBILE HOME PARK ENTRANCE, BENSON-DOUGLAS HWY APPENDIX 7.2
80		23-1(2),(3)		10.76A	Jan-77	VALENCIA QUADRANGLE
82	00-082-A-503	82-A-503	37	DDS	Apr-04	SUM. & ANALYSES OF CULVERTS, E OF JCT SR 83 MP 37.50 TO MP 39.20
83	None					
87		53-1-(45)	220	DDS	Jan-97	WISKEY SPRINGS BR. DECK DRAIN. CALC
87		53-1-(33)	222	DDS	Nov-94	PINE CK (W FORK SYCAMORE CK-MP226)
87	F-053-1-306	53-1(8)	226	10.67	Jan-77	MARICOPA LN^ORD MINE
87	F-053-1-410	53-1(511)	228.7	DDS	Aug-81	ORD MINE-JCT S188
87	87-B-(1)	Tracs #H5264 01C	229.63	DDS	Oct-01	SLATE CREEK TO ORD MINE, DRAINAGE DITCH ANALYSIS, MP 229.63 TO MP 230.1
87	FBP-053-1-410	53-1(10)	229.7	10.61	Jan-86	ORD MINE-JCT S188
87	F-053-1-515	53-1(515)	235	DDS	Oct-87	SR 87 @ DEER CREEK, JCT SR188 - RYE -HYDROLOGY
87	F-053-1-515	53-1(515)	235.6	DDS	Jun-88	SR 87 @ DEER CREEK, JCT SR188 - RYE -HYDRAULIC DESIGN
87		53-1(505)	235.7	DDS	Mar-88	RYE CREEK VOL 1 & 2
87	F-053-1-410	53-1(512)	237.9	DDS	Apr-86	ORD MINE-JCT S188
87		53-1(939)	239.4	MICRO	Nov-79	RYE CRK SCOUR PROT
87	F-053-1-409	53-1(9)	246.7	10.79	Oct-76	OXBOW HILL-PAYSON
87	F-073-1-401	73-1(1)	250	10.8	Jul-78	JCT S260-N PAYSON
87	N-900-319	900-319	250	DDS	Jan-93	PAYSON DRAINAGE STUDY:SR 87 & 260
87	F-073-1-301	73-1(501)	253.4	DDS	Aug-88	JCT S260-AIRPORT RD
87	F-073-1-303	73-1(503)	263.2	DDS	Aug-88	PAYSON - PINE
87	F-073-1-402	73-1(2)	267.5	MICRO	Dec-84	PINE CRK WDNG & APR
87	F-073-1-302	73-1(502)	270.5	DDS	Sep-88	JCT FOSSIL CREEK RD
87	S-282-303	282-(3)	290	10.52	Jan-70	LONG VALLEY SECTION
87	S-282-303	282-(3)	290	10.69	Jan-72	LONG VALLEY SECTION
87	S-282-304	282-(504)	309	10.81	Jun-69	QUAIL HILL SECTION
87	S-282-305	282-(509)	316.8	10.81	Dec-69	FORST BDRY-JCK CYN
87	S-087-C-510	Tracs #H6157 01D	341.3	DDS	Nov-05	RUBY CHANNEL BRIDGE #1485
87	S-282-313	282-(513)	341.6	10.76	Jan-77	VIRGINIA AV ACCESS
87	S-282-313	282-(513)	341.6	10.76A	Jan-79	VIRGINIA AVENUE ACC
87	BR-087-D(001)	Tracs #H5767 01C	344.95	DDS	Apr-03	LITTLE COLORADO BRIDGE #1484
87	S-244-303	244-(2)	347	10.57	Jan-64	JCT U66-NORTH
87	S-244-312	244-(512)	390	10.8	Jan-77	POLACCA-JEDITO WASH
87	S-244-307	244-(509)	420	10.8	Jan-71	ORAIBI UNIT II&III
87	S-244-311	244-(511)	426	10.8	Mar-71	ORAIBI W.-BIG MT.
87	F-053-1-313PE	53-1-313PE	201 to 226	DDS	Feb-89	SAGAUARO LK RD-GILA CNTY LINE (V.3)
87	STP-053-1(31) (1996)	53-1(31)	218.5 to 226	DDS	Jun-96	SEGMENT F BRIDGES: SUNFLOWER, LOWER KITTY JOE, WHISKEY SPRING, UPPER KITTY JOE & COTTONWOOD BASIN BRIDGES
90	F-013-1-203		289	DDS	Jan-01	I-10 INTERCHANGE TO SR 90 MP 291
90	STP 013-1(13)		289	DDS	May-98	I10 - KARCHNER CAVERNS STATE PARK

Route #	Project No.	(File Number) Updated (6/18/03)	M.P.	Loc	Date	Remarks
90		13-1(9)	299	DDS	Feb-99	KARTCHNER CAVERNS - WHETSTONE
90	F-013-1-312		306	DDS	Aug-96	BABOCOMARI RIVER AND RAIN VALLEY WASH
90	F-013-1-312		306.5	DDS	Oct-97	WHETSTONE TO HUACHUCA CITY
90	F-013-1-306		313	DDS	Aug-90	HUACHUCA CITY SOUTH
90	F-013-1-305	13-1(505)	317	DDS	Mar-88	EAST GATE-CHARLESTON
90	F-012-1-308	12-1(508)	319	10.6	Jan-71	SIERRA VISTA STS
90	F-013-1-304	13-1(504)	321.7	DDS	Aug-88	SIERRA VISTA - EAST
90	F-012-1-422	12-1(23)	331.1	10.66	Jan-71	MILLER-ASH CANYONS
92	F-012-1-425	12-1(509)	317.3	10.6	Jan-73	EAST GATE-JCT SR92
92	S-577-301	577-(501)	324.5	DDS	Sep-85	GARDEN CANYON BR
92	F-012-1-422	12-1(22)	326	10.51	Jan-70	RAMSEY-MILLER CYNS
92	F-012-1-422	12-1(23)	331.1	10.51	Jan-70	MILLER-ASH CANYONS
180	F-051-1-406	51-1(7)	322	10.51	Jan-72	PETRIFIED FOREST, II
180	F-051-1-406	51-1(8)	327.5	10.51	Jan-72	PETRIFIED FOREST, II
180	F-051-1-409	51-1(9)	337.7	10.57	Jan-74	BEAVER DAM WSH-HUNT
180	F-051-1-404	51-1(4)	342.8	10.51	Jan-70	HUNT-CONCHO CREEK
180	S-984-414	984-(14)	344	MICRO	Dec-82	SANDERS-NO NAME
180	F-051-1-413	51-1(13)	364.2	10.79	May-77	BIG HOLLOW BRIDGE
180		80785	376	DDS	Aug-95	PICNIC HILL DRAINAGE
180	F-051-2-410	51-2(11)	403	DDS	Mar-70	PICNIC HILL SECTION
180	F-051-2-410	51-2(510)	407.5	MICRO	Jul-81	PICNIC HILL SECTION
180		51-2-515	409	DDS	Jul-90	NUTRIOSO CREEK
180	F-051-2-305	51-2(20)	416.6	DDS	Jul-89	NUTRIOSO SECTION
180	F-051-1-409	51-2(12)	419	10.6	Jan-75	NUTRIOSO-ALPINE
180	F-051-1-409	51-2(9)	421.9	10.6	Jan-75	NUTRIOSO-ALPINE
180	F-051-2-409	269-(504)	421.9	10.69	Jan-74	MUTRIOSO-ALPINE I
180	S-269-301	269-(2)	426.5	10.52	Jan-69	ALPINE-LUNA LAKE
180	F-051-2-410	51-2(10)	497.5	DDS	Jun-77	NELSON RESVR SECTN
186	S-274-301	274-(501)	326.2	10.52	Jan-70	REX ALN DRW-WILLCOX
186	S-273-303	273-(503)	359.8	10.61	Jan-73	JCT S186-S181
186	S-273-302	273-(502)	366.7	10.52	Jan-70	IDEAL DRAW SECTION
191		Tracs #H5720 01C	38	DDS	Jun-04	SUNIZONA TO PEARCE
191	191-B(003)B	Tracs # H5037 03C	87.4	DDS	Mar-03	SEGMENT 1, MP 87.4 TO MP 91.6
191	H5037 06C		97.7	DDS	Apr-03	SEGMENT IV, MP 97.7 TO MP 100.8
191		57-1(505)	118	DDS	Aug-93	JCT. SOLOMON RD./32
191	F-051-2-322	Tracs #H3030 01D	144	DDS	Jan-02	GREENLEE COUNTY LINE TO MP 151.28 (VOLUMES II AND III)
191	NH-191-C-003		151	DDS	Mar-04	MP 151 TO THREEWAY (TRACS #H3030)
191		51-2(23)C	154.6	MICRO		BUZZARD ROOST
191		51-2(35)	155.6	DDS	Sep-96	BUZZARD ROOST CANYON BR. # 0252
191	H6815		173-174	Gdrive	Dec-05	UPPER CHASE CREEK, MP 173 TO 174
191	U191-D-301	Tracs #4360 01D	367 to 369	DDS	Nov-02	NAHA'TA' DZIIL ROAD TO SANDERS TI
260	N-900-319	900-319	250	DDS	Jan-93	PAYSON DRAINAGE STUDY:SR 87 & 260
260		53-2(33)	260	DDS	Jan-00	CHRISTOPHER CREEK DESIGN SECTION
260		53-2(22)	260.1	DDS	Mar-99	PREACHER CANYON SECTION
260		53-2(22)	261	DDS	Sep-97	PREACHER CANYON BRIDGE HYDROLOGY & HYDRAULICS
260	STP-053-2 (40)	Tracs #4699 01D	262	DDS	Feb-02	LITTLE GREEN VALLEY SECTION
260		53-2-425	266	DDS	Sep-00	KOHL'S RANCH SECTION
260	F-053-2-306	53-2(506)	268.2	DDS	Feb-89	KOHLS RANCH
260	H5906 01C		280	DDS	Nov-04	GORDON CANYON BRIDGE & MOGOLLON RIM VIADUCT EROSION MITIGATION

Route #	Project No.	(File Number) Updated (6/18/03)	M.P.	Loc	Date	Remarks
260	F-053-2-308	53-2-308 (PE)	302	DDS	Oct-92	HEBER-OVERGAURD
260	F-053-2(20)	53-2(20)	302	DDS	Jul-91	HYD. ANALYSIS OF BRIDGES OVER BLACK CANYON & BUCKSKIN WASHES
260		53-2-308	302	DDS	Jun-90	HEBER - OVERGUARD
260	STP-053-2(20)	53-2(20)	304	DDS	Mar-94	PAYSON-SHOW LOW HWY -VOLUMES I AND II
260	260-B-(2)	260-B-(2)	306	DDS	Oct-02	JCT 277 TO OVERGAARD
260	F-053-2-407	53-2(7)	314.7	10.52	Jan-70	ARIPINE SECTION
260	F-053-2-410	53-2(10)	325.1	10.61	Jan-72	PINEDALE SECTION
260	F-053-2-409	53-2(9)	325.7	10.61	Jan-73	CLAY SPRINGS SECTN
260	F-044-1-402	44-1(2)	341.7	10.57	Jan-86	JCT US60-SO-SHOWLOW
260	S-260-C-506		342	DDS	May-05	STORM DRAIN TO RELIEVE A RESIDENTIAL FLOODING PROBLEM NEAR MP342
260	F-044-1-401	44-1(1)	342.1	10.57	Jan-82	SHOWLOW-LAKESIDE
260	F-044-1-413	44-1(13)	342.1	DDS	Mar-87	SHOWLOW-LAKESIDE II
260	F-044-1-409	44-1(9)	344.2	DDS	Apr-87	SHOWLOW-LAKESIDE I
260	F-044-1-301	44-1(6)	351.6	DDS	Jan-82	STREETS OF LAKESIDE
260	STP-044-1(20)P	44-1(20)	353	DDS	Jan-01	PINETOP - HON DAH
260		260-NA-338		DDS	Jan-95	LINDEN RD TO JCT US 60
377		554-(903)	0.1	10.83	Jan-76	S77-S277 JUNCTION

Nonpoint Education for Municipal Officials (NEMO) produces watershed-based plans, which are reports that are the result of a coordinated effort by the ADEQ, the Arizona Cooperative Extension Service, and the Technology and Research Initiative Fund. Arizona NEMO integrates watershed management and planning with research-based, professional education in order to engage stakeholders and foster better land use decisions to protect Arizona's water resources. Emphasis is on the linkages between water quality and land use, as well as water quantity and supply. NEMO watershed studies have been published for the following rivers in this study area:

- Upper Gila watershed
- Verde watershed
- Middle and Lower San Pedro watershed
- Little Colorado watershed

Additional watershed studies will be available after 2008 for the Salt River, Santa Cruz River, and middle Gila River watersheds.

The information in these NEMO reports can provide valuable insight into overall watershed extents, delineation of subbasins, soils characteristics, land use, aerial imagery, and vegetation type and density for large-scale drainage studies associated with roadway corridor studies. Additional information includes modeled stream flows (for comparison with ADOT hydrologic models), stream density (miles of stream per square mile of drained area), average slopes, stream/precipitation gauge locations, and anticipated sediment loads from each watershed's subbasin.

The soil information for much of the area has been mapped and cataloged by the Natural Resources Conservation Service (NRCS) and the USFS. These data are used to estimate infiltration losses for watersheds.

The NRCS publishes soil surveys for all or part of the counties in Arizona and around the country. These soil surveys include soil unit maps, profiles, descriptions, and hydrologic characteristics. In some of the less populated or less developed counties, only general soil surveys were done prior to 1950.

Several areas that have experienced more growth or agricultural development have more detailed soil surveys available (circa 1964 through 2003). See Table 2-7, Soil Surveys, for a complete list of published soil surveys within the study area. Nearly all these soil surveys have been digitally updated since the original hard copies were published. Where indicated, the updated portable data format (PDF) versions of those soil survey reports and geospatial soil datasets are available online on the NRCS website. The USFS equivalent of the NRCS soil survey reports are geeral scosystems Surveys or terrestrial ecosystem surveys.

Terrestrial ecosystem surveys have more detailed information and smaller-scale mapping (1:24,000) than the general ecosystem surveys (1:250,000 scale mapping). Refer to Table 2-7, Soil Surveys, for a complete list of the surveys available at the time of this study. Note that the USFS is in the process of writing new terrestrial ecosystem surveys for some of the national forests in the region, but these will not be completed until approximately 2013. Requests for the most recent terrestrial ecosystem surveys must be directed to the forest supervisor's office of each respective national forest. The individual ranger districts seldom have these reports available for distribution.

Table 2-7 – Soil Survey Table

Natural Resources Conservation Service (NRCS)

County Covered	Title	Published Date	Current Version Online
Apache	Apache County — Central Part	1975	yes
Apache, Gila & Navajo	Fort Apache Indian Reservation, Parts of Apache, Gila, and Navajo Counties	1981	yes
Coconino	Beaver Creek Area (Wet Beaver Creek)	1967	yes
Cochise	General Soils Map	1978	
Cochise	Benson Area	1921	
Cochise	Cochise County — Douglas - Tombstone Part	2003	yes
Cochise	Cochise County — Northwestern Part	2007	yes
Cochise	Gila-Duncan Area, Parts of Graham and Greenlee Counties	1981	yes
Cochise	San Simon Area	1980	yes
Cochise	Willcox Area, Parts of Cochise and Graham Counties	1976	yes
Coconino	Long Valley Area	1974	yes
Coconino	Coconino Area — Central Part	1983	yes
Gila	General Soils Map	1974	
Graham	Duncan Area	1950	
Graham	General Soils Map	1973	
Graham	Gila Valley Area, Middle	1917	
Graham	Gila Valley Area, Upper	1938	
Graham	Safford Area	1970	yes
Greenlee	General Soils Map	1973	
Navajo	Holbrook - Show Low Area	1964	
Navajo	Navajo County — Central Part	2003	yes
Navajo	Winslow Area	1921	

Natural Resources Conservation Service (NRCS)

County Covered	Title	Published Date	Current Version Online
Santa Cruz	Nogales Area	1930	
Santa Cruz, Cochise	Santa Cruz County and Parts of Cochise and Pima Counties	1979	yes

NOTE: The Soil Conservation Service soils reports are included in this list, in addition to the more recent NRCS reports.

US Forest Service

National Forest	Title	Published Date	Current Version Online
Apache-Sitgreaves NF	Terrestrial Ecosystems Survey of Apache-Sitgreaves NF; USDA Southwest Region	1989	no
	Maps at 1:24,000 scale		
Coconino NF	Terrestrial Ecosystems Survey of Coconino NF; USDA Southwest Region	1995	no
	Maps at 1:24,000 scale		
Tonto NF	Terrestrial Ecosystems Survey of Tonto NF; USDA Southwest Region	1985	no
	Maps at 1:18,000 scale		
	Report 1 — North third of the forest		
	Report 2 — Northeast part of the Globe Ranger District		
Coronado NF	General Ecosystems Survey of Coronado NF; USDA Southwest Region	1991	no
	Maps at 1:250,000 scale		

2.2.3 Natural Infrastructure

Biotic communities occur within all three focus areas, except where specifically noted. Distribution data for individual species may change, and habitat ranges vary as a result of species movement or surveys of new areas. However, this study only identifies the major ranges of individual species by county, because surveys were not conducted for this study.

Biotic Communities

The study area supports incredibly diverse flora and fauna across many elevations and different biotic communities. Within the study area, there are 11 different biotic communities ranging from desertscrub communities to chaparral, woodlands, and grasslands.

The Arizona Upland division of Sonoran desertscrub covers approximately 6.8 percent of the study area. This biotic community is characterized by leguminous trees such as foothills paloverde (*Parkinsonia microphylla*), ironwood (*Olneya tesota*), and mesquites (*Prosopis* spp.). Cacti are abundant and include the saguaro cactus (*Carnegia gigantea*), cholla (*Cylindropuntia* spp.), barrel cactus (*Ferocactus* spp.), and pincushion cactus (*Mammillaria* spp.). Annual precipitation generally ranges between 12 and 17 inches, with summer rainfall accounting for 30 to 60 percent of the annual total. Elevations range from approximately 980 to above 3,280 feet (Brown 1994).